Longevity in Australian snapper *Pagrus auratus* (Sparidae)

Jeffrey V Norriss & Brett Crisafulli

Western Australian Fisheries & Marine Research Laboratories,
PO Box 20, North Beach, WA, 6920
✉ Jeffrey.Norriss@fish.wa.gov.au
✉ Brett.Crisafulli@fish.wa.gov.au

Manuscript received December 2009; accepted April 2010

Abstract

In fisheries biology, longevity is one of the estimators of natural mortality, an essential parameter for age-based stock assessments. Increased fishing pressure progressively truncates older fish from the population, highlighting the importance of documenting observations of exceptionally old individuals. Snapper (*Pagrus auratus*) constitute important fisheries around the southern half of mainland Australia. A literature search and survey of government and semi-government agencies responsible for managing snapper fisheries in 5 Australian states reveals the species is capable of living to at least 40 years throughout much of its range. The oldest recorded age, from near Bunbury, Western Australia, was recently estimated to be 40 years and 10 months.

Keywords: longevity, snapper, *Pagrus auratus*, age, mortality, otolith

Introduction

Potential longevity is inversely related to natural mortality. In fisheries biology, maximum age can be used to estimate the natural mortality rate (Hoenig 1983; Hewitt & Hoenig 2005), an essential parameter in many mathematical models of fish stock dynamics (Vetter 1988). Unfortunately the use of maximum age can become problematic in many fisheries because fishing pressure has already removed older fish from the population (Berkeley *et al.* 2004) before the age of exceptionally old individuals can be recorded.

In Australia, snapper (*Pagrus auratus*) is an iconic species that has a continuous distribution around the southern half of the mainland. It supports important commercial and recreational fisheries throughout its range (Kailola *et al.* 1993). Otolith based age estimates of Australian snapper show that it can live to over 30 years of age (McGlennon *et al.* 2000; Coutin *et al.* 2003; Wakefield 2006; Jackson 2007; Wise *et al.* 2007; Lenanton *et al.* 2009).

Documenting the age of exceptionally old snapper before they are removed by fishing preserves the capacity to estimate natural mortality from maximum age, perpetually enhancing the accuracy of age-based fishery assessments and helping to avoid a potential "shifting baseline syndrome" (Pauly 1995) in longevity reference points. This short note documents observations of exceptionally old snapper from wild Australian fisheries for use in mathematical stock assessment models.

Methods

The accepted method for ageing Australian snapper is to interpret the alternating opaque and translucent zones delineated annually in sagittal otoliths, combined with a nominal birth-date during peak spawning gauged from a time series of gonad developmental stages and a gonadosomatic index (McGlennon *et al.* 2000; Ferrell & Sumpton 1998; Coutin *et al.* 2003; Wakefield 2006; Jackson 2007; Lenanton *et al.* 2009). This method was used for all ages reported in this study.

The investigation to find Australia's oldest recorded snapper involved consulting published literature that reported data on snapper ages. Furthermore, government and semi-government agencies in each Australian state responsible for managing snapper fisheries and monitoring the age structure of catches were contacted in May 2009 and asked to provide details of the oldest snapper recorded in their respective states from unpublished reports or databases. These agencies were Queensland Primary Industries and Fisheries (QPIF), the New South Wales Department of Primary Industries (NSWDPI), Victoria's Department of Primary Industries (VDPI) in association with the Victorian based Fish Ageing Services Pty Ltd (FAS), the South Australian Research and Development Institute (SARDI), and the Department of Fisheries Western Australia (DFWA).

The instantaneous rate of natural mortality (M) was estimated from the age of the oldest recorded Australian snapper using:

1. Hoenig's (1983) regression equation for fish;
2. Hewitt & Hoenig's (2005) rule-of-thumb approach using their estimated appropriate value for the proportion of animals in the stock that survive to the maximum age: $P = 0.015$; and
3. Hewitt *et al.*'s (2007) indirect method No. 3, using the von Bertalanffy growth parameter estimate of $K = 0.14$ from Lenanton *et al.* (2009).

Results

Very old snapper with estimated ages of approximately 40 years were recorded from Victoria and Western Australia, and only slightly younger ages of

Figure 1. Australia's oldest recorded snapper (40 years and 10 months) captured approximately 9 nautical miles west of Bunbury, Western Australia.

about 37 years were reported from South Australia and New South Wales (Table 1). Several annuli in the otolith of the oldest snapper from New South Wales were indistinct, leading to some imprecision among repeated counts.

Australia's oldest recorded individual snapper (Figure 1) was aged at 40 years and 10 months, generating a natural mortality estimate of M = 0.10 using both the methods of Hoenig (1983) and Hewitt & Hoenig (2005), and an estimate of M = 0.05 using Hewitt *et al.*'s (2007) method. The fish was captured on 1 September 2007 and therefore a member of the 1966 year class. The otolith had 41 delineated opaque zones and a translucent margin less than 50% of the width of the previous translucent zone (Figure 2), indicating that the last formed opaque zone had delineated recently. The total length and length to caudal fork were 935 and 826 mm, respectively.

Table 1

Summary of the oldest recorded snapper from five Australian states. Source acronyms given in Methods.

Age (yrs)	Sex	Date of capture	State and location of capture	Source
23	M	15 Oct 2007	QLD, Brisbane	QPIF
ca 37	?	19 Oct 1994	NSW, northern coastal	NSWDPI
40.4	M	9 May 2001	VIC, Port Phillip Bay	VDPI, FAS
36.9	M	16 Dec 2000	SA, north Spencer Gulf	SARDI
40.8	M	1 Sep 2007	WA, Bunbury	DFWA

Discussion

Snapper of approximately 40 years of age from two widely separated locations in Victoria and Western Australia, and only slightly younger fish from South Australia and New South Wales, suggest the species can live to at least 40 years of age throughout much of its range. New South Wales had the largest annual snapper catch of all states from 1964–65 to 1982–83 (Kailola *et al.* 1993), a level of fishing which may have removed very old individuals, suggesting that longevity potential in that state may be higher than the approximately 37 years observed.

The low estimates of natural mortality for snapper throughout much of their range indicate this species is susceptible to over-fishing (Adams 1980). If stocks are fished at high levels the number of exceptionally old individuals is likely to decline in many locations and may not be encountered again. The longevity observations and natural mortality estimates in this study therefore form reference points that set a baseline for future age-based snapper fishery assessments.

Footnote: Recently Gomon *et al.* (2008) referred to snapper as *Chrysophrys auratus*, citing genetic research by Orrell & Carpenter (2004).

Acknowledgements: We appreciate the assistance of the Australian snapper research community, including Stephen Wesche at QPIF, John Stewart at NSWDPI, Patrick Coutin at VDPI, Kyne Krusic-Golub at FAS, Tony Fowler at SARDI, and Gary Jackson and Corey Wakefield at DFWA. Thank you also to Bruce Olsen, the recreational fisher in Figure 1 who volunteered his snapper frame to help the DFWA research program, and became an Australian record holder!

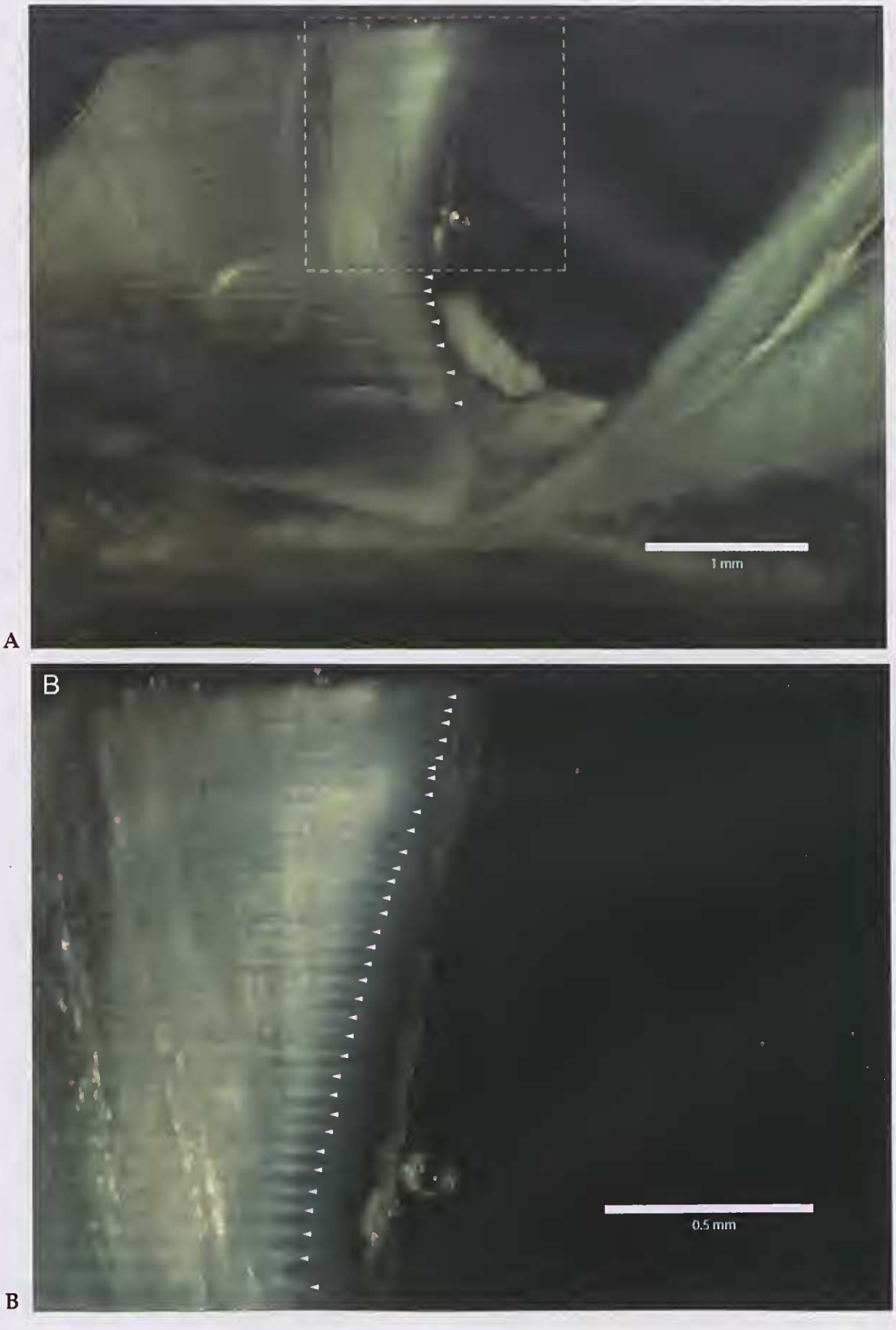

Figure 2. Cross section through sagittal otolith from oldest known Australian snapper highlighting 41 opaque zones. Boxed area in A is magnified in B. Reflected light.

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